THE ROLE OF LIGHT INTENSITIES IN BIRD MIGRATION

By John V. Dennis

Various theories have been advanced as to why certain birds migrate by night and others by day. None to me seem very convincing. The idea that birds migrate by night to avoid winged predators seems particularly untenable. The hazards of night flight (collisions, losses at sea, etc.) seem far greater than those of day. If evolutionary forces were at work to provide the safest time of travel for each species, I think most, if not all birds, would end up as diurnal migrants. Another theory is that birds regulate their time of flight to provide for proper feeding conditions. This viewpoint scarcely holds water in light of present-day knowledge. Birds are known to take on heavy fat deposits prior to their migratory flights. Some species of land birds apparently can fly non-stop from between 1,500 and 2,000 miles. But most take much shorter hops and in between hops stop to rest and feed for a few days.

There are other theories, but this discussion of necessity must be limited.

It is well known that light intensities play an important role in the selection of the breeding niche. Each forest type has its avifauna, the composition of which changes as the forest becomes either more open or closes over. Various factors are involved in these changes but light intensity seems to be the most important. Likewise each species has its range limitations. Ranges change almost constantly but there are apparently physiological barriers that preclude expansion in certain directions or areas. Light intensity, according to some authorities, is the stimulus that acts upon a bird's endocrine system to initiate migration.

And now to indulge in some highly speculative reasoning, I shall go on to the possible role of light intensities in the time of day that migration takes place. At the start I shall hazard several assumptions: that eyesight in birds is adjusted to certain ranges of light intensity, that some birds are much more sensitive to light than others, and that a bird outside its normal light tolerances in daylight is under discomfort and may lose the power to judge distances, motion and so on.

Every bird watcher is familiar with the discomfort of owls during the daylight. Owls can see what is going on, but appear powerless to exact punishment upon the flocks of birds that torment them from time to time. This, of course, is an extreme example. Mist netting has led me to believe that other birds as well have difficulty in perception during bright daylight. Ability to avoid

nets varies from almost zero in most thrushes and some of the shade dwelling warblers to almost a hundred percent in swallows and swifts. Kingbirds are only slightly less adept at avoiding nets than swallows.

Birds such as wood thrushes seem incapable of keeping out of nets whether the nets are in deep shade or the sumlight of open places. But in shade or semi-darkness mist nets do not provide a fair test of vision for then they are truly invisible or nearly so. Except when nets are placed at the nesting site, swallows are expert in avoiding them. At the nesting site parental instinct may prompt them to go in despite the fact that they see the net. Indeed, most birds of very open country, particularly those that hawk after insects or dive for fish, are difficult to take in nets.

This is not true, however, of most birds that inhabit grasslands or weed fields. Sparrows are generally easy to capture. One wonders if they may not go into nets even when nets are visible to them. I have suspected this and suppose it is natural for them to push their way through interlacing grassy foliage that differs little in appearance from a mist net.

Terns, shorebirds, and the black skimmer appear to be very keen sighted and able to adjust their vision to a variety of situations. Most of them feed at night, and probably most migrate both by night and day.

Birds with widely adaptable vision seemingly are not under compulsion to conform either to day or night migration. It is becoming more and more evident that a large percentage of our birds migrate both by day and night. There are few strictly diurnal migrants, although, as far as I know, swallows, swifts, kingbirds, flickers, and hawks adhere wholly to a diurnal schedule.

The compelling factor which limits certain birds to migration at night, I would guess, is sensitiveness to bright light intensities. These intensities may well be of such a disadvantage to birds of limited light tolerance that many have no alternative but to migrate by night. Until recently little thought seems to have been given to possible deleterious effects of the sun upon birds. That the sun causes "obvious discomfort" and at times forces birds into a compulsory sun-bathing position has been studiously examines by Doris C. Hauser ("Some Observations on Sun-bathing Birds", Wilson Bull. 69(1): 78-90. 1957). She feels that heat is not entirely the motivating factor in these responses. The role of light intensity is not discussed, but it is of interest that most of the examples of what appear to be "heat prostration" recorded by Mrs. Hauser occurred on feeding trays exposed to the full rays of the sun and under a wide variety of temperatures. It might be added that before banders realized the importance of tending

mist nets constantly they did have casualties in nets exposed to the full rays of the sun. I do not have figures on the length of time a semi-immobile bird can endure the sun on a hot, cloudless day, but I doubt it is over half an hour. Some species might be expected to be more resistant to exposure than others.

An entirely different hazard, but one which reveals extreme sensitiveness to light, is seen in the frequent calamities that occur at night when birds are attracted by ceilometer beams, beacons, and the like.

Under some circumstances nocturnal migrants are forced to undertake a certain amount of daylight flying. This often occurs during long overwater flights. Though departure occurred at night, the distance might be so great that the landfall would not take place until daylight. It is of interest that under most conditions birds arriving after overwater flights do not put down immediately, particularly if the terrain is open and treeless. The urge apparently is to reach suitable protection from bright daylight. This does not apply so much to birds that normally inhabit open situations.

Vision is not the only factor in taking birds in nets, of course. Birds that feed close to the ground, for instance, stand a much better chance of being caught than birds of higher levels. But at the same time the ground dwellers are largely shade-inhabiting species. Their eyes are proportionately large and presumably they experience difficulty in adjusting their vision to bright light. Also bright light may very well prove discomforting to them in other ways.

Another group is intermediate between the above species and the swallows in their ability to avoid nets. I would place almost 80 percent of the birds I take in a group which ranges from birds of the open country such as the goldfinch to woodland birds such as the chickadees and tufted titmouse. Generally speaking, nets partially camouflaged or shaded by trees and shrubbery take these birds but nets in sunlight, or exposed to wind, or silhouetted against a background do not. On one occasion I had four or five nets in the open surrounding a small vegetable garden. Sparrows feeding in the plot avoided

Besides thrushes (with the exception of the bluebird and robin which inhabit relatively open areas), I have found that the following species are among the easiest to take in nets: worm-eating warbler, ovenbird, yellow-breasted chat, the waterthrushes, hooded and Kentucky warblers, catbird, white-throated sparrow, white-crowned sparrow, and the Empidonax flycatchers. Phoebes and wood pewees are almost equally easy to take. The smaller flycatchers, although they do some food finding in open situations, seem generally adapted to a fair amount of shade. Their vision is peculiar in that they can see small insects in mid-air but are particularly helpless about avoiding nets.

nets on three sides but readily went in nets on the fourth. Flight toward the fourth was toward the late afternoon sun and this factor was enough to impair the vision of the birds.

I attach importance to the visual test with mist nets because it signifies wide differences in vision among different species and different groups. Although a consistent pattern isn't always evident, species which are least apt to detect or avoid nets are those which inhabit shady situations and, at the same time, are those which habitually migrate by night. Nocturnal migration may therefore be connected directly with the vision factor. And closely related to this is the little understood problem of the possible harm that may result when birds are exposed to sunlight beyond whatever their physical tolerances may be.

I wish to avoid a technical discussion since the subject of the structure of the eye, temperature tolerances, and the like, is extremely involved and requires knowledge of an extensive and difficult literature. But I would like to quote from a recent letter I have received from Mrs. Hauser which adds food for thought.

In speaking of nocturnal migrants, she writes: "I believe that these birds choose to fly at night in order to escape the penetrating effects of solar radiation -- whether it b e the ultra-violet rays or some other even more obscure quality of the sun. The Icteridae which fly over my yard (Fayetteville, N.C.) in great flocks during the fall migrations, over a period of several weeks, are seen in the morning hours, up until 9:30 or 10 A.M., and again in the late afternoon, from 4 until 6 P.M. I would suggest that large flocks of migrating birds are rarely, if ever, seen in flight during the mid-day hours, when the ultra-violet rays 'have a minimum of atmosphere to penetrate and hence a maximum of penetration.' (The Story of Man, Carleton S. Coon, Alfred Knopf. 1957)."

She goes on to quote the following from the above book: "'In man, as in animals and birds, races seem to exist for the principal purpose of accomodating the organism to differences in heat, visible light and U-V radiation... The human eye is also concerned with U-V regulation. The lens, while transparent to visible light, in all races completely absorbs atmospheric U-V, thus removing a potential source of blindness.'"

Note: This is an informal discussion undertaken with the hope that readers will become interested in this fascinating side of bird migration. Original ideas should be sent to EBBA NEWS or to the writer at 17 Liberty Street, Nantucket, Mass.

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